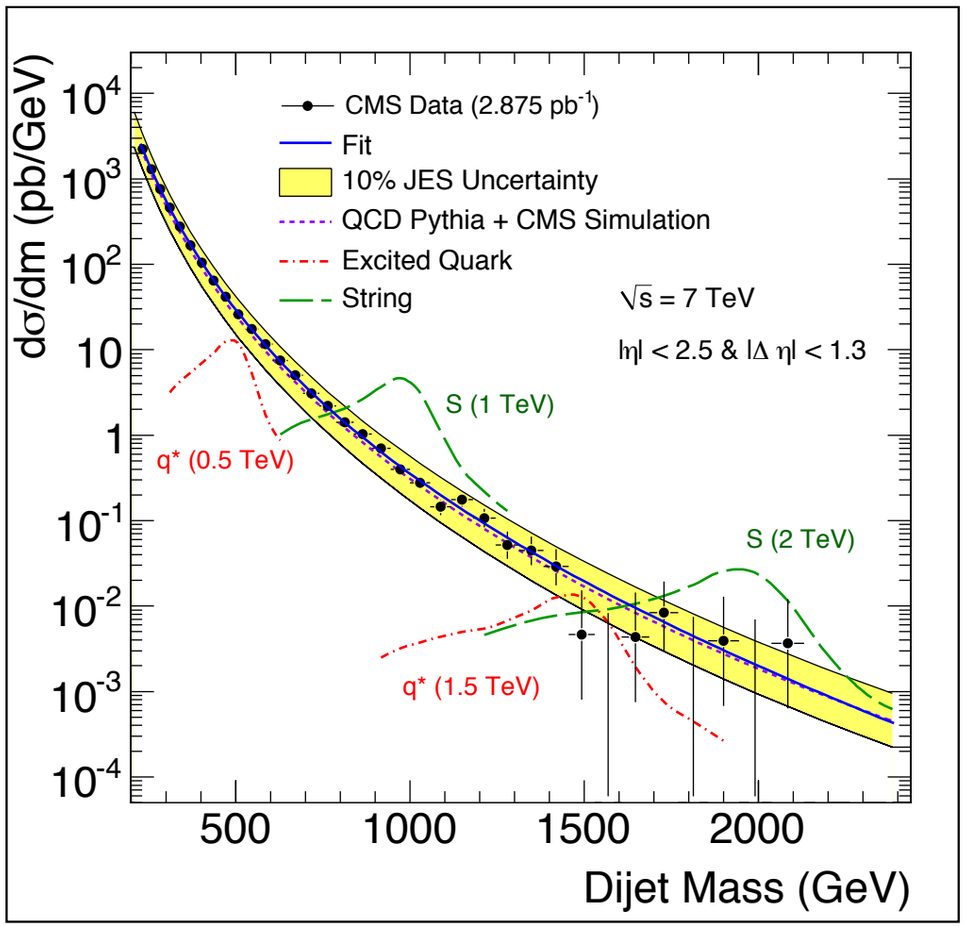
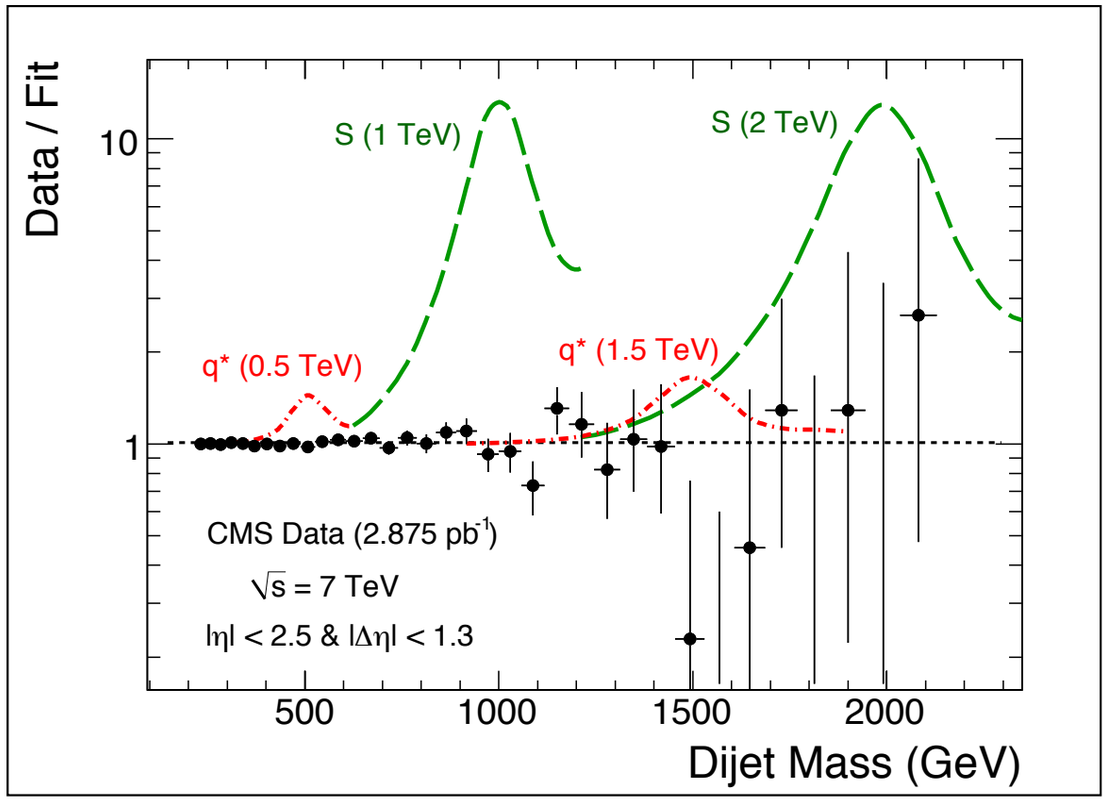
Search for b-bbar Resonance in 7 TeV Proton-Proton Collisions at CMS

Sertac Ozturk

for b-jet resonance group

Motivation



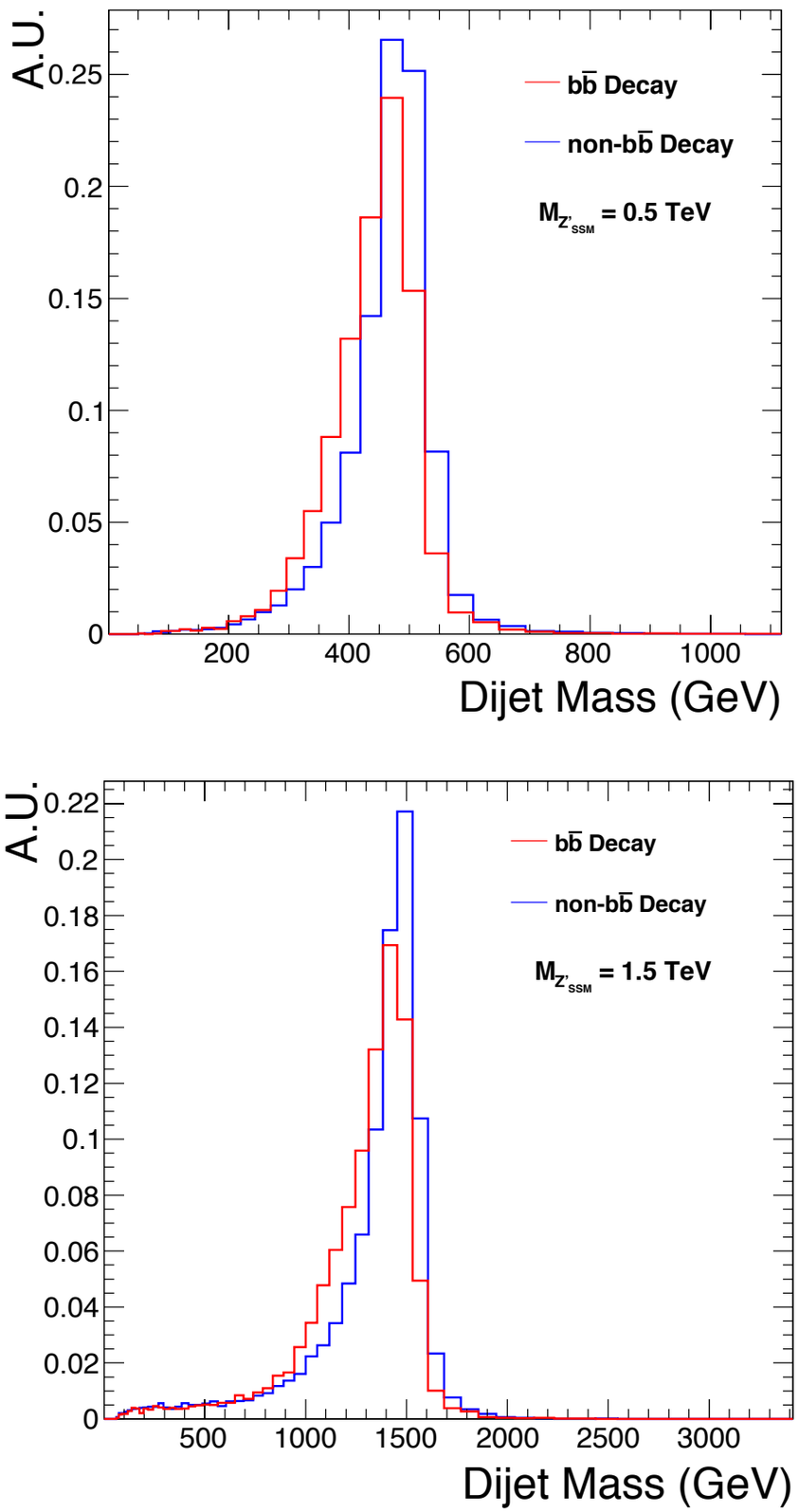


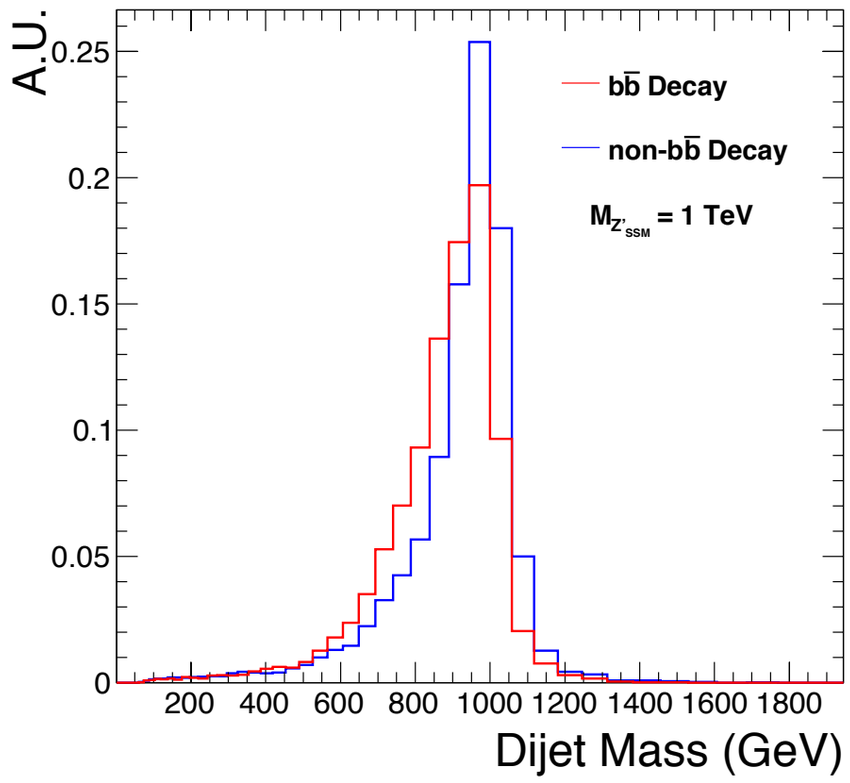
- We search for the new particles in "Dijet Mass" spectrum.
  - ✓ If a resonance exists, it can show up as a bump in Dijet Mass spectrum
  - ✓ It was considered as qq, qg and gg resonances.
- We would like extend this study to b-jet resonances.

MC Production and Event Selection

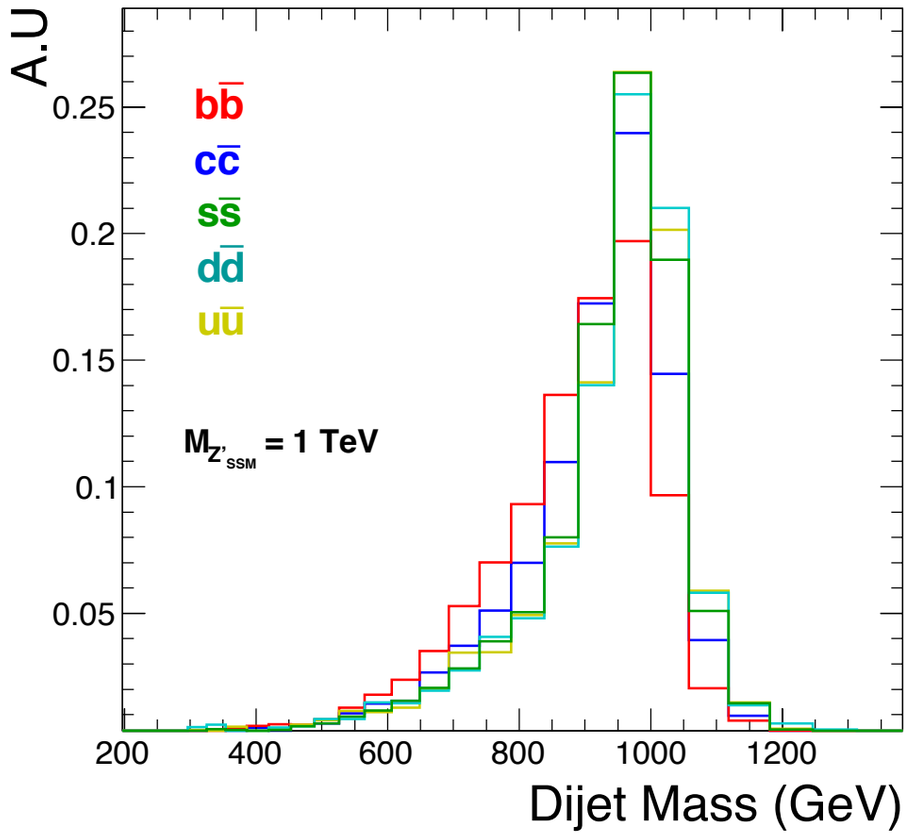
- ☑ Since b decay mode was off in official Spring10 Z' to dijet MC sample, new MC samples were generated using FastSim.
  - ✓ CMSSW_4_1_2patch1
  - ✓ Z'_{SSM} at the mass of 0.50, 0.75, 1.00, 1.25,1.50, 2.00 and 2.50 TeV
  - ✓ /castor/cern.ch/user/s/sertac/ZprimeSSM
- ☑ AK7 PFJets
- ☑ $|\eta|<2.5$ & $|\Delta\eta|<1.3$
- ☑ L2L3 Jet Energy Correction

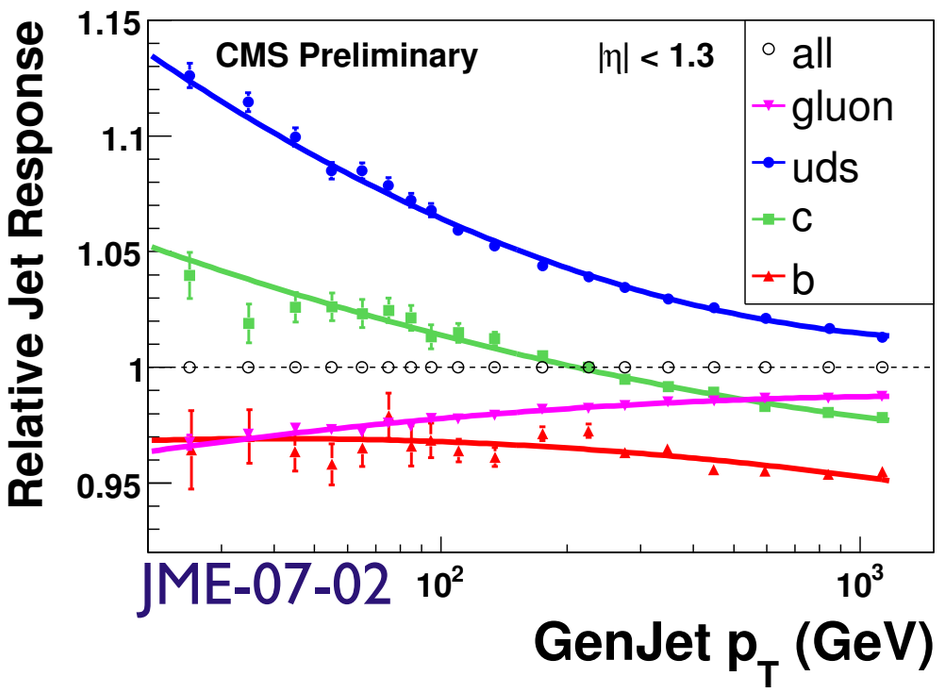
Resonance Shapes





- The signal of b-bbar resonances is shifted to lower mass region and wider than non-bbbar resonances.





- ☑ The resonance shapes for different quark resonance pairs are shown.
- ☑ b-quark has the worst response and resonance shape of bb resonances is shifted to lower mass region.
- ☑ Width of resonance shape for bb resonances is wider comparing the others resonances.

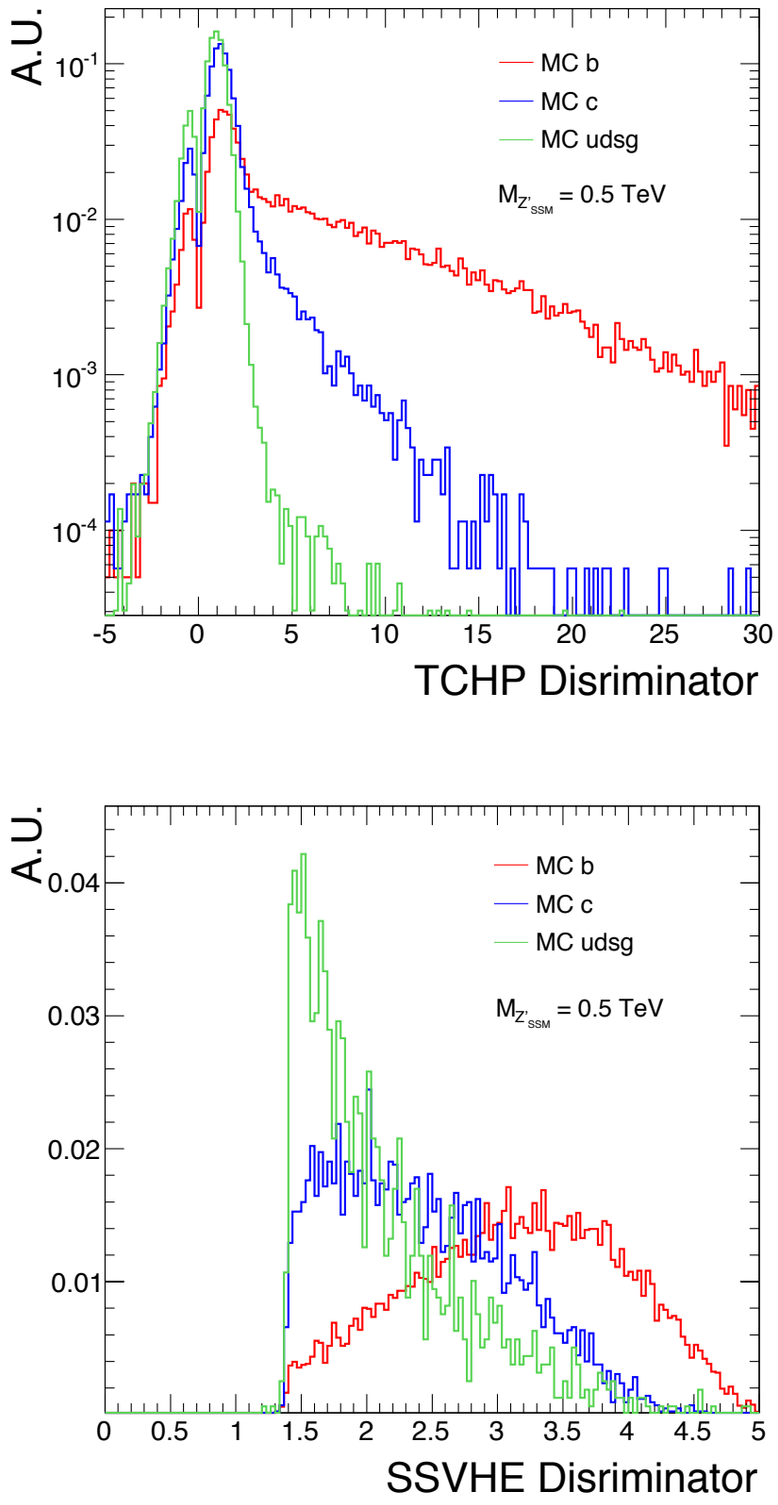
B-Tagging Algorithms

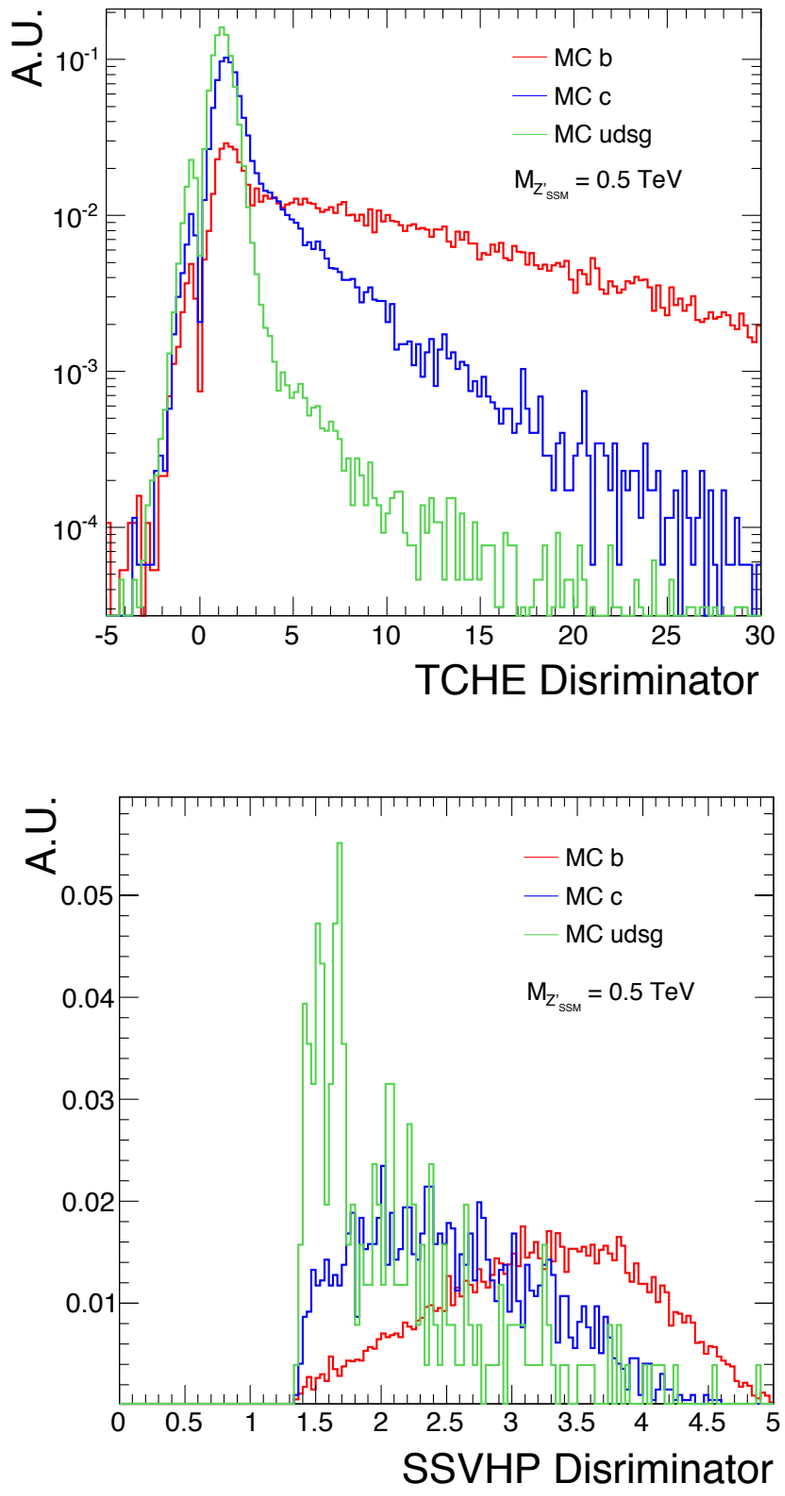
- ☑ Two b-tagging algorithms are considered.
  - ✓ Track Counting (High Efficiency and High Purity)
  - ✓ Simple Secondary Vertex (High Efficiency and High Purity)
- ☑ The discriminant threshold cuts are chosen based on CMS AN 2010-147.

Table 1: definition of the operating points for different b-taggers.

b-tagger	operating point	threshold (D_{cut})
Track Counting High Efficiency Loose	TCHEL	1.70
Track Counting High Efficiency Medium	TCHEM	3.30
Track Counting High Purity Medium	TCHPM	1.93
Track Counting High Purity Tight	TCHPT	3.41
Simple Secondary Vertex High Efficiency Medium	SSVHEM	1.74
Simple Secondary Vertex High Efficiency Tight	SSVHET	3.05
Simple Secondary Vertex High Purity Tight	SSVHPT	2.00

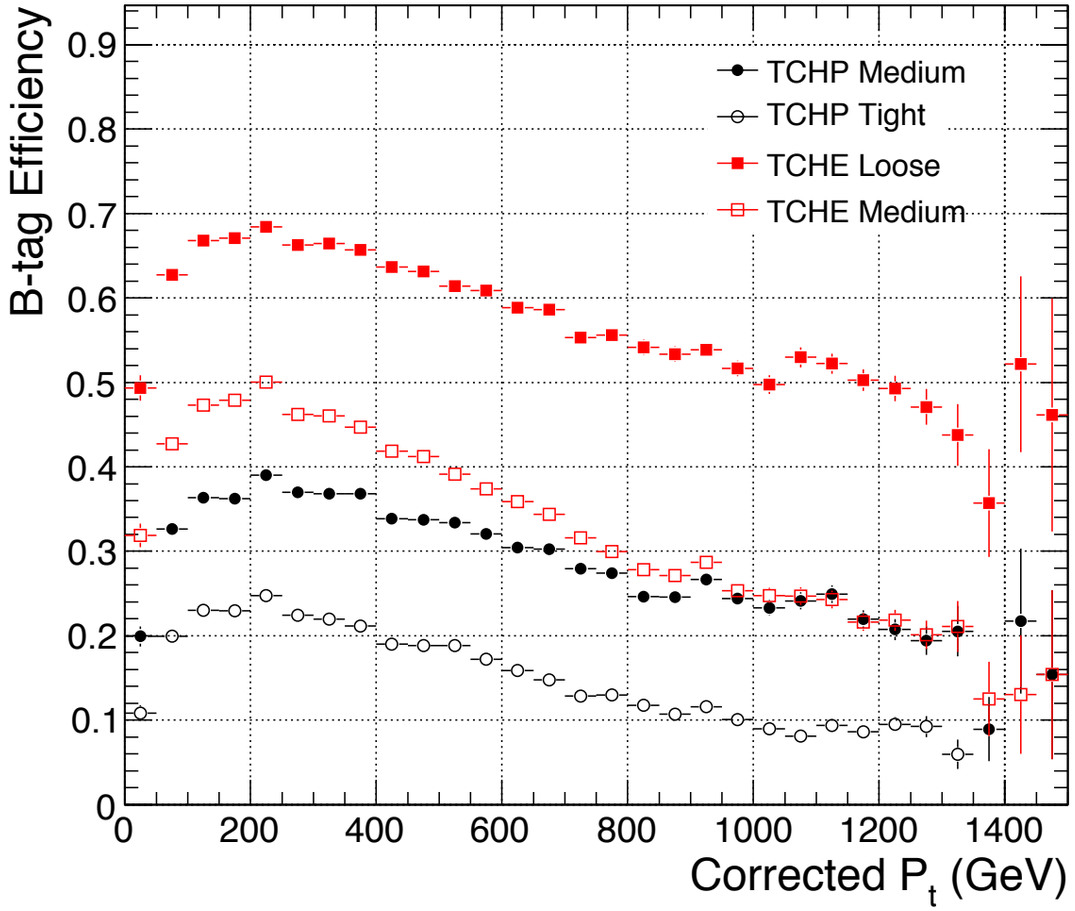
B-Tagging Discriminant

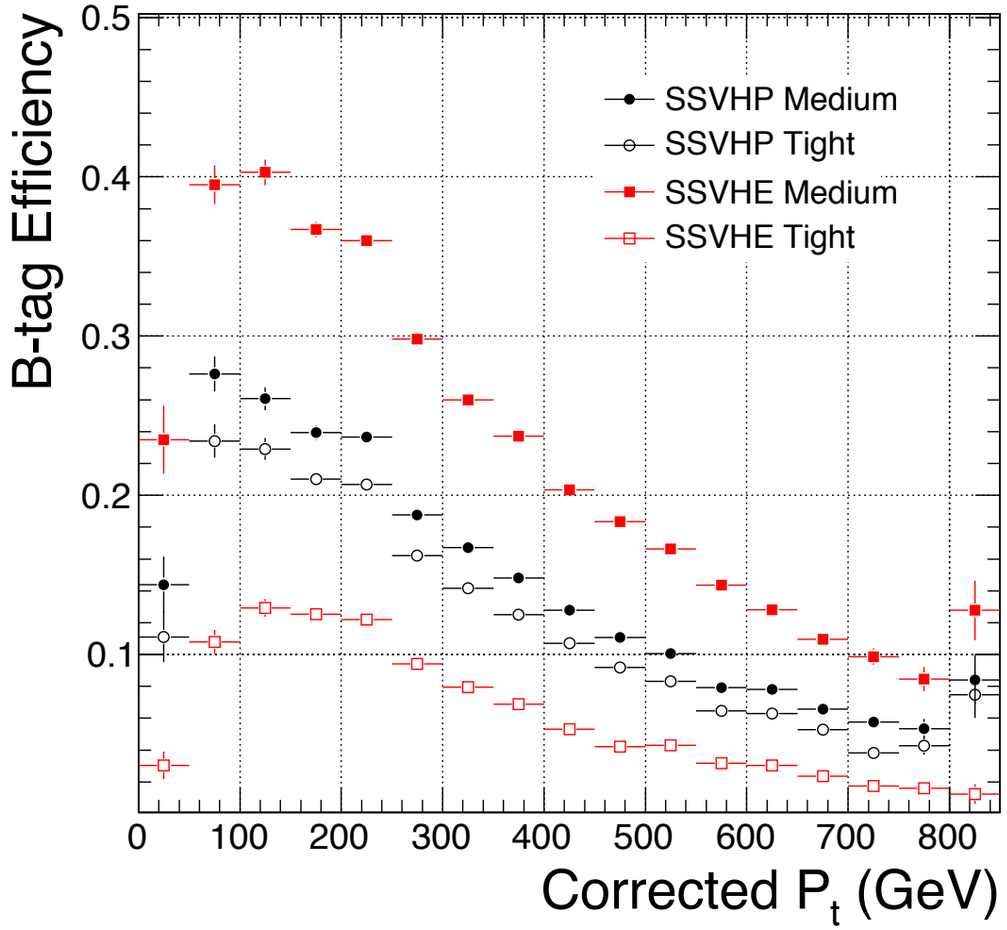




B-Tagging Efficiency vs Pt

- b-tagging efficiency as a function of corrected pt of two leading jets are shown.
- Track counting (TC) algorithms have better efficiency than Simple Secondary Vertex (SSV) algorithms at high pt.
- TCHE with loose discriminator cut (D>1.70) has the best efficiency.

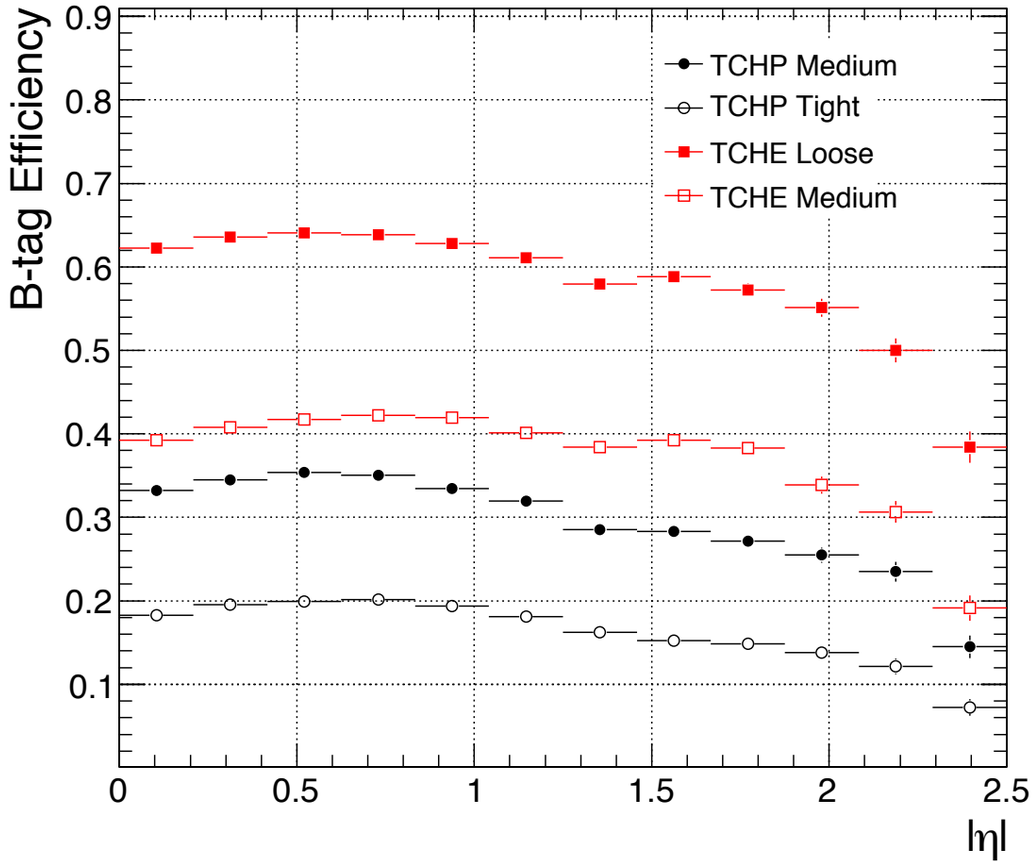


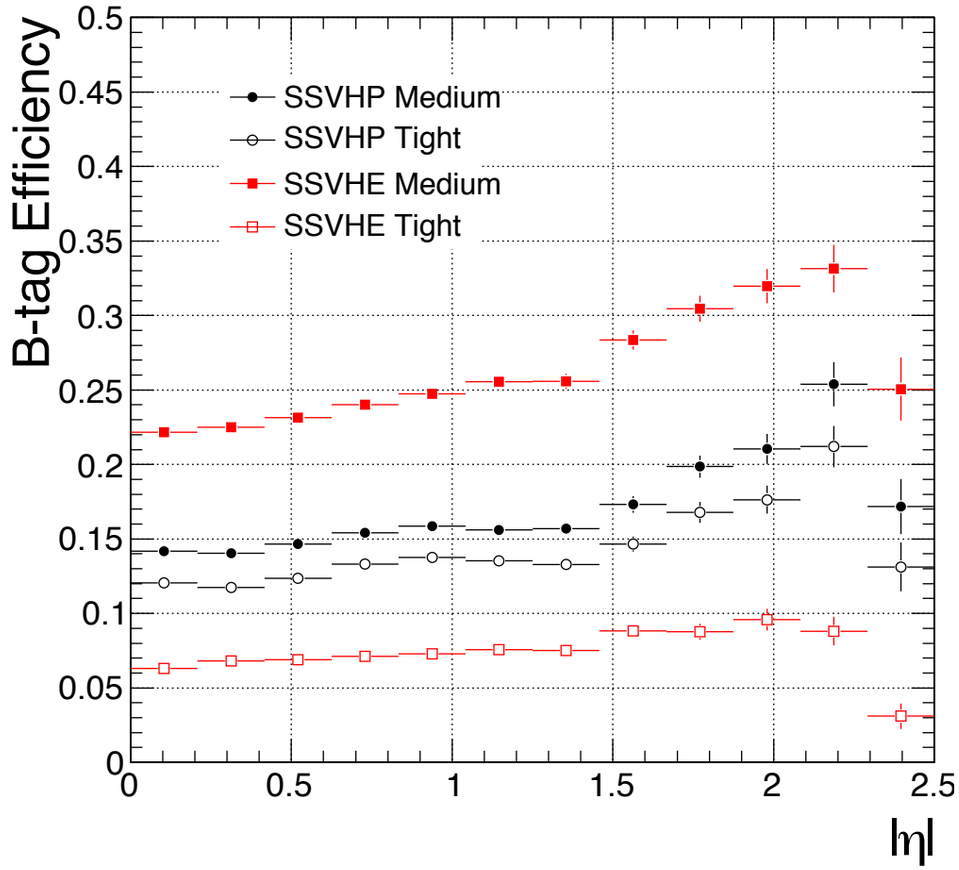


B-Tagging Efficiency vs η

☑ b-tagging efficiency as a function of eta of two leading jets are shown.

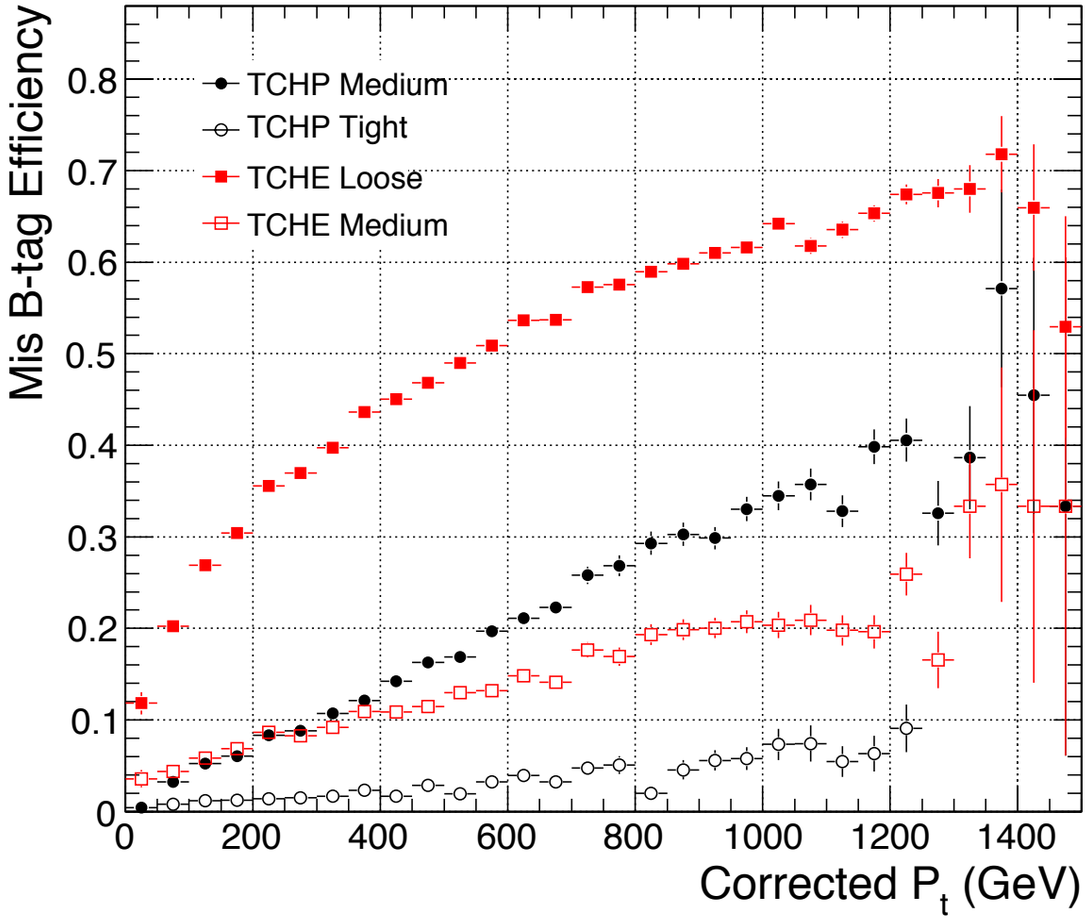
✓ for TCHE, TCHP, SSVHE and SSVHP.

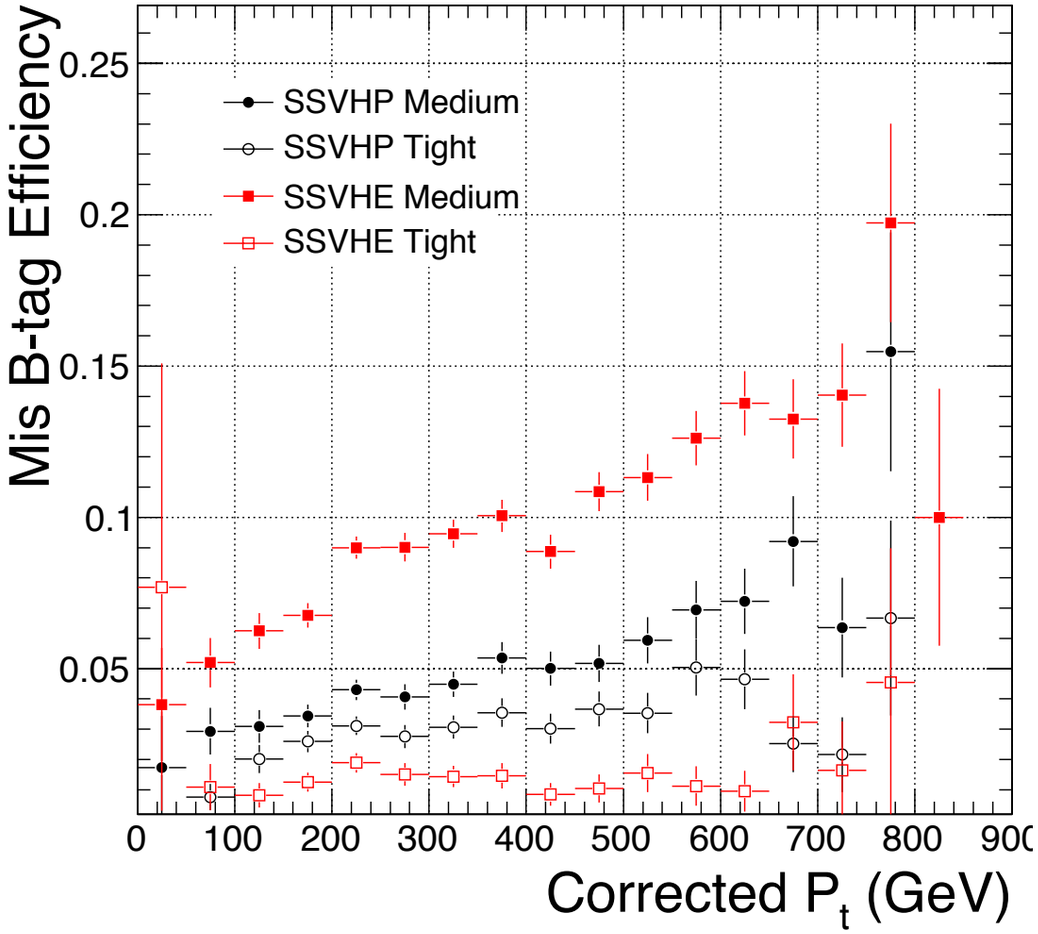




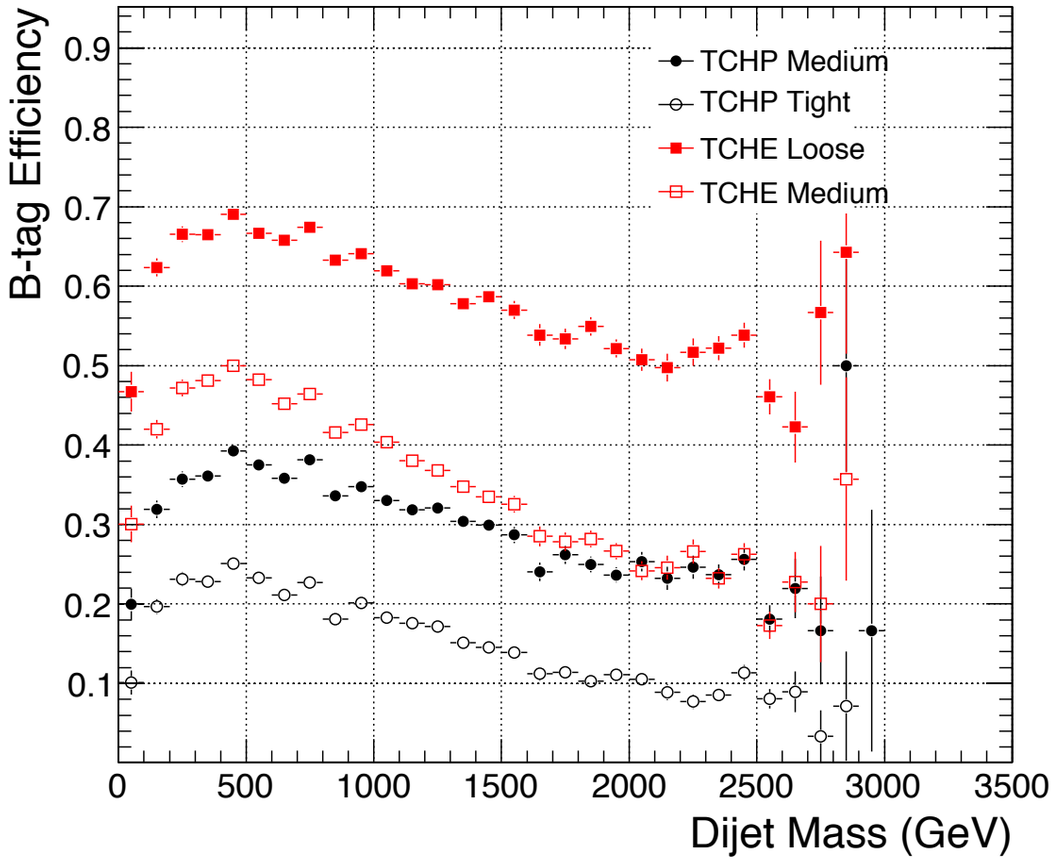
Mis b-tagging

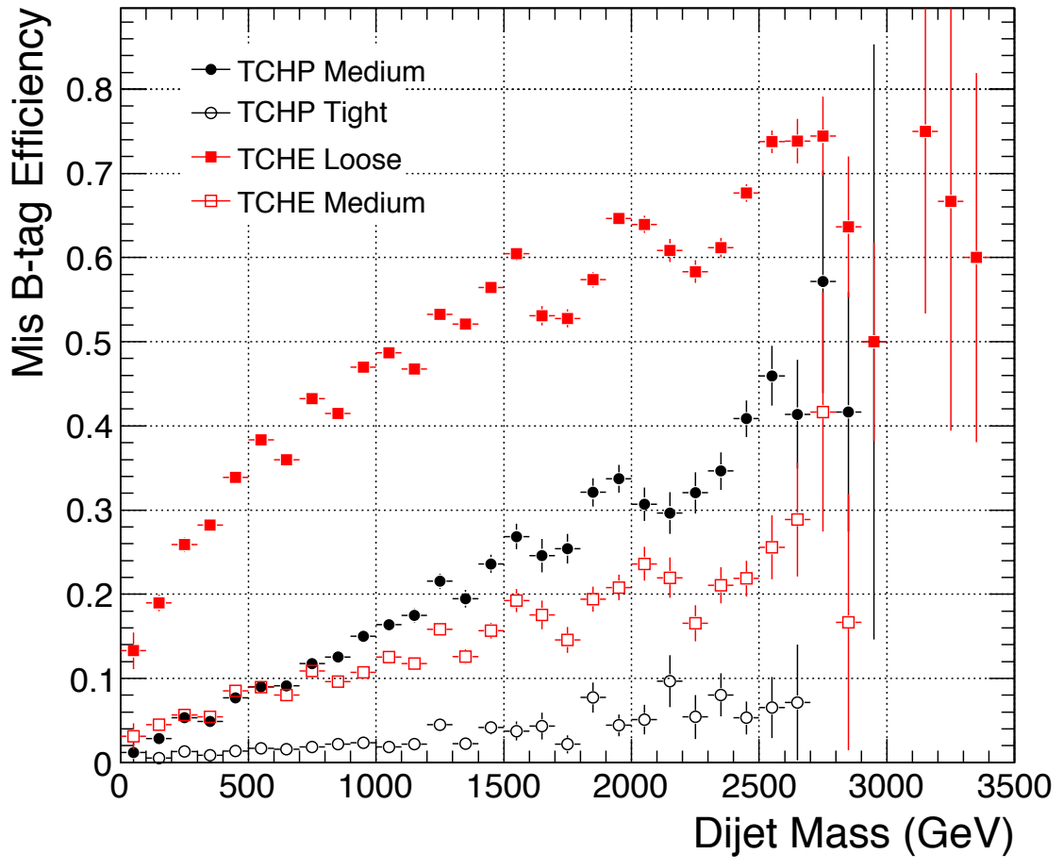
- Mis b-tagging efficiency as a function of corrected pt of two leading jets are shown for TC and SSV.
- Mis b-tagging rate for TCHE with loose discriminator cut (D>1.70) is vey high.
  - ✓ It cannot be considered in b-jet resonance analysis.
- TCHE with medium discriminator cut (D>3.30) has lower mis b-tagging efficiency and higher b-tagging efficiency than TCHP medium discriminator cut (D>1.93).





b-tagging vs Dijet Mass





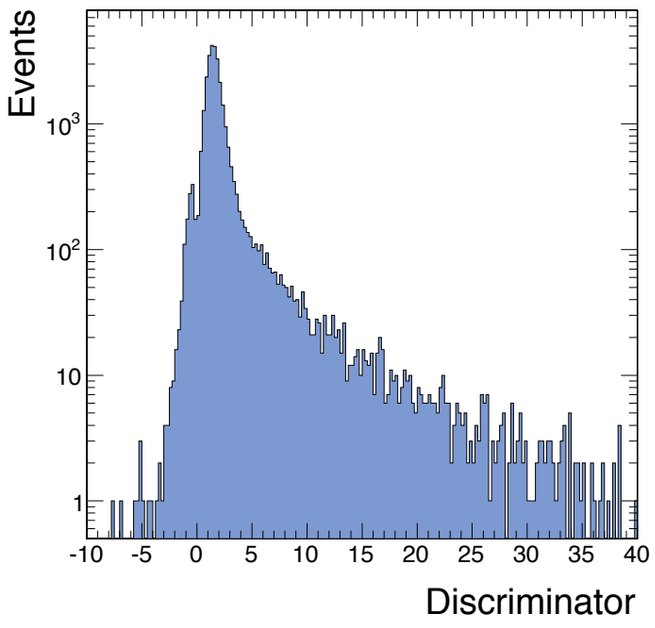
- ☑ b-tagging efficiency and mis b-tagging efficiency as a function of corrected dijet mass are shown.
- ☑ TCHE with medium discriminator cut (D>3.30) looks like the best option for b-jet resonance search.

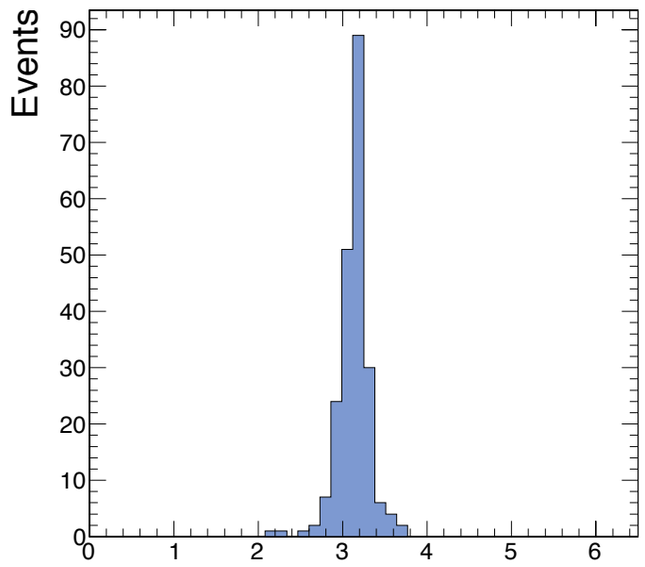
Data Analysis

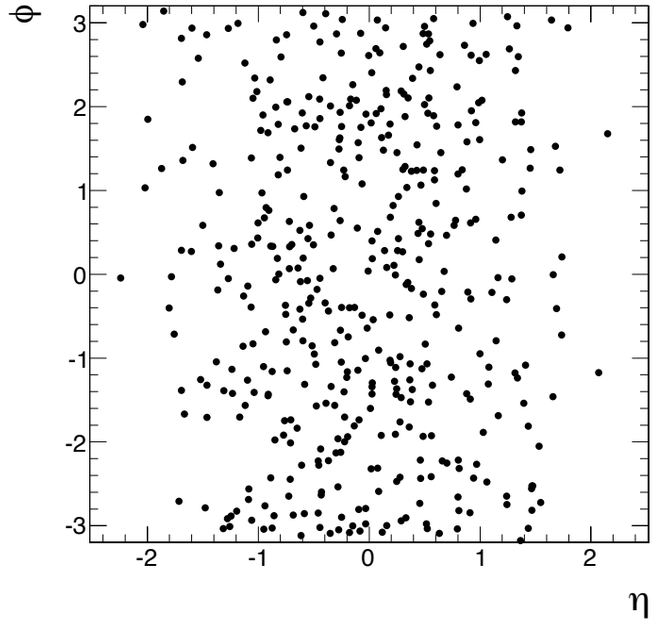
- ☑ Dataset
  - ✓ /Jet/Run2011A-PromptReco-v1/AOD (161404-162717)
  - ✓ /Jet/Run2011A-PromptReco-v2/AOD (162717-163233)
- ☑ Cert_160404-163369_7TeV_PromptReco_Collisions11_JSON.txt
- ☑ Event Selection
  - ✓ Unprescaled Jet Trigger (HLT_Jet240_v1 & HLT_Jet300_v1)
  - ✓ AK7 PFJets
  - ✓ |PVz| < 24 cm && PVndof > 3
  - ✓ |η|<2.5 & |Δη|<1.3
  - ✓ Both leading jets passing the "loose" jet id
  - ✓ Mjj > 788 GeV
- ☑ JEC (L1Offset, L2, L3, L1L2L3Residual) (https://twiki.cern.ch/twiki/bin/view/CMSPublic/WorkBookJetEnergyCorrections#JetEnCor2010)
- ☑ B-Tagging
  - ✓ TCHE with medium discriminator cut (D>3.30) for both leading jets
- ☑ Integrated Luminosuty: 41.6 pb-1

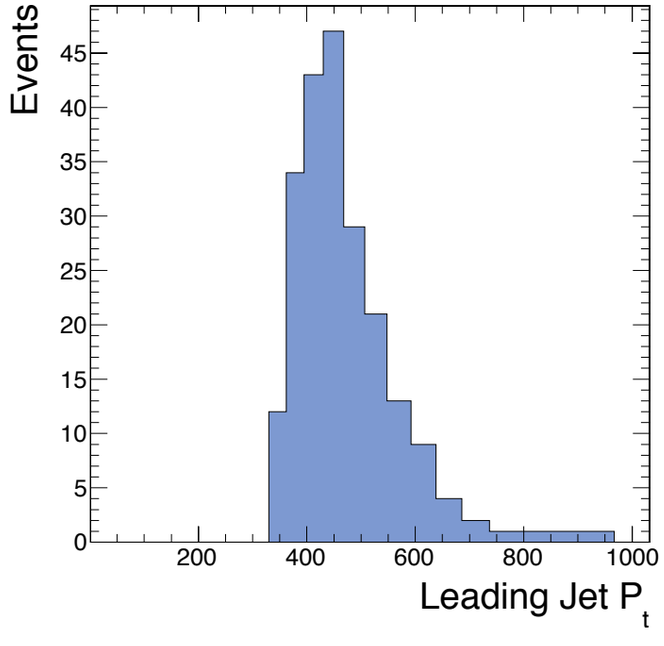
b-tagged Dijet Events

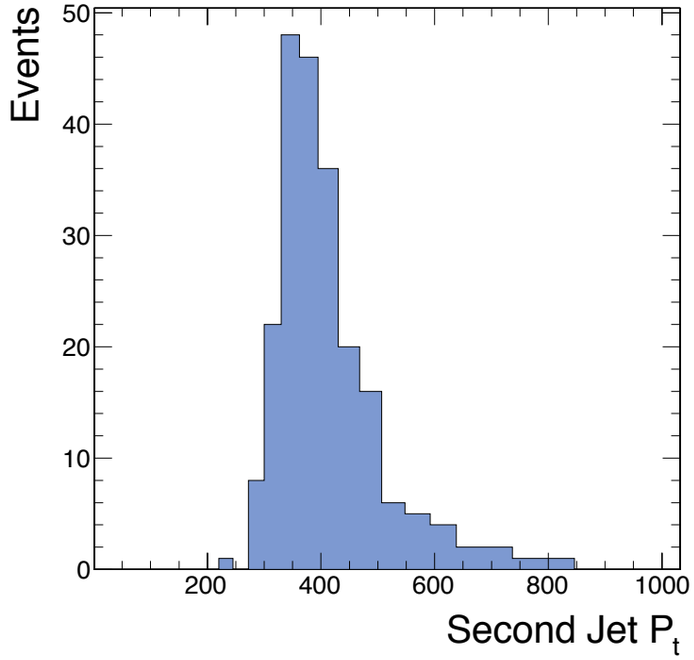
- ☑ Total: 218 Event
  - ✓ Jet1 Disc>3.30 & Jet2 Dics>3.30





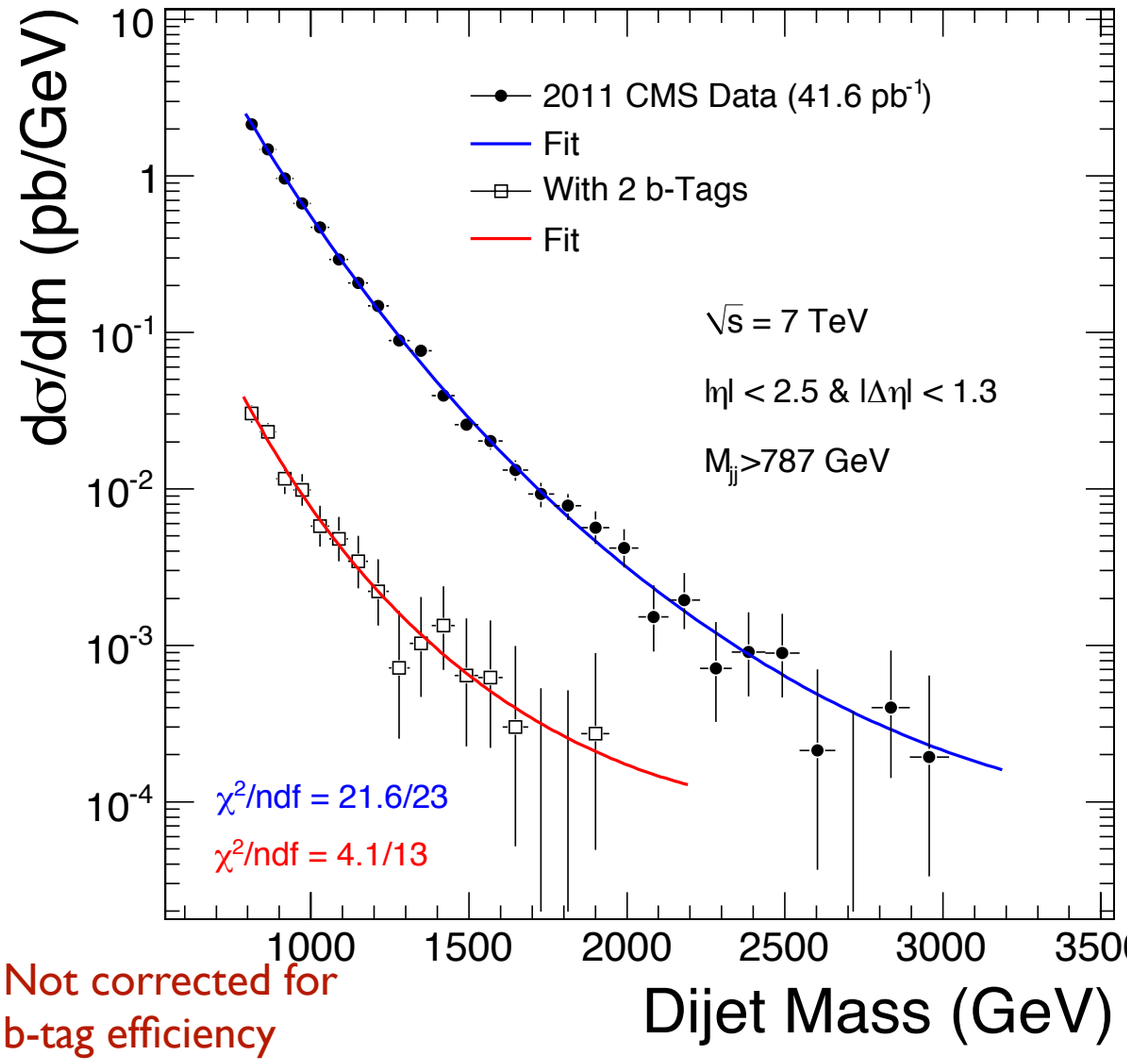






Dijet Mass and Fit

- ☑ We fit the data to a function containing 4 parameters used by the CMS paper.
- ☑ We get a good fit.
- ☑ No evidence for new physics.



Not corrected for b-tag efficiency

$$\frac{d\sigma}{dm} = p_0 \frac{(1-X)^{p_1}}{X^{p_2+p_3\ln(X)}} \qquad x = m_{jj}/\sqrt{s}$$